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(54) Title: SYSTEMS AND METHODS FOR CURING A FLUID

(57) Abstract: Systems and methods for curing inks with radiation. An apparatus includes a housing that includes a pair of reflectors and/or two separate lamps of different power that direct ultraviolet radiation onto the inks being cured. The pre-cure reflector only reflects a portion of the radiation such that the inks are not fully cured. The pre-cure reflector causes the inks to change or thicken slightly such that they do not move on the media or merge with other inks while still retaining a liquid or wet nature. All colors of ink can then be placed in a single layer before the cure reflector fully cures the UV inks by reflecting sufficient UV radiation onto the single layer of UV ink.

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1. In a printing system using at least one ink curable with radiation, an illuminator for directing radiation to cure the at least one ink, the illuminator comprising:

a housing;

a radiation source located within the housing;

a pre-cure reflector positioned within the housing, the position of the pre-cure reflector within the housing being configured to direct radiation from the radiation source to the at least one ink to change a viscosity of the at least one ink without fully curing the at least one ink; and

a cure reflector mounted within the housing, the mounting of the cure reflector within the housing being configured to direct radiation from the radiation source to the at least one ink to fully cure the at least one ink.

2. An illuminator as defined in claim 1, wherein the housing is configured to be connected with print heads of the printing system.

3. An illuminator as defined in claim 1, wherein the pre-cure reflector comprises one or more of of:

a parabolic mirror;

an elliptic mirror;

a mirror;

a lens; and

a prism.

4. An illuminator as defined in claim 1, wherein the pre-cure reflector is positioned within the housing at a position that is further away from the radiation source than the cure reflector such that the pre-cure reflector directs less intense radiation to the inks, wherein the at least one ink is pre-cured by the pre-cure reflector.

5. An illuminator as defined in claim 1, further comprising a filter that blocks a portion of the radiation reflected by the pre-cure reflector, wherein the filter is connected to a bottom of the housing.

6. An illuminator as defined in claim 1, further comprising a lens connected to a bottom of the housing, wherein the lens transmits radiation reflected by the pre-cure reflector and the cure reflector such that radiation reflected by the pre-cure reflector pre-cures the inks and radiation reflected by the cure reflector fully cures the inks, wherein the lens reflects heat such that the media is not altered by the heat.

7. An illuminator as defined in claim 1, wherein the radiation source comprises a low power lamp and a high power lamp, wherein the pre-cure reflector directs radiation from the low power lamp to the at least one ink and wherein the cure reflector directs radiation from the high power lamp to the at least one ink.

8. In a printing system using inks that are cured using ultraviolet radiation, an illuminator for curing the inks, the illuminator comprising:

an ultraviolet radiation source located in a housing, wherein the ultraviolet radiation source generates the ultraviolet radiation used to cure the inks;

pre-curing means, mounted within the housing, for directing the ultraviolet radiation to the inks to pre-cure the inks; and

curing means, mounted within the housing next to the pre-curing means, for directing the ultraviolet radiation to the inks to fully cures the inks that have been pre-cured.

9. An illuminator as defined in claim 8, wherein the pre-curing means comprises a pre-cure reflector that is positioned within the housing such that the radiation reflected by the pre-cure reflector is less intense than the radiation reflected by the curing means.

10. An illuminator as defined in claim 8, wherein the pre-curing means comprises:

a pre-cure reflector mounted with the housing, wherein the pre-cure reflector reflects radiation from the radiation source to the inks; and

a filter that blocks a portion of the radiation reflected by the pre-cure reflector such that a viscosity of the inks is changed without fully curing the inks.

11. An illuminator as defined in claim 8, wherein the pre-curing means comprises a pre-cure lamp and wherein the curing means comprises a curing lamp.
12. An illuminator as defined in claim 11, wherein the pre-cure lamp emits less power than the curing lamp.
13. An illuminator as defined in claim 8, wherein pre-curing means comprises:
 - a pre-cure reflector mounted with the housing, wherein the pre-cure reflector reflects radiation from the radiation source to the inks; and
 - a lens that transmits radiation from the radiation source on the inks such that a viscosity of the inks is changed without fully curing the inks, wherein the lens reflects heat generated by the radiation source such that a media is not altered by the heat.
14. An illuminator as defined in claim 8, wherein the curing means comprises a cure reflector mounted within the housing, wherein the cure-reflector reflects radiation to the inks such that the inks are fully cured.
15. An illuminator as defined in claim 8, wherein the housing is configured to be connected with print heads of the printing system.

16. An illuminator as defined in claim 8, wherein the pre-curing means comprises at least one of:

- a parabolic mirror;
- a parabolic mirror;
- an elliptic mirror;
- a mirror;
- a lens; and
- a prism.

17. An illuminator as defined in claim 8, wherein the pre-curing means is positioned within the housing at a position that is further away from the radiation source than the curing means such that the pre-curing means directs less intense radiation to the inks.

18. In a printing systems that uses UV inks, a method for printing the inks on a media that reduces the tendency of wet UV inks to run or merge and that prevents the UV inks from being printed in more than one fully cured layer, the method comprising:

for each ink, pre-curing the wet ink that has been printed on the media such that a viscosity of the inks is changed without fully curing the ink, wherein each ink is pre-cured by an illuminator that reflects radiation to each ink using a pre-cure reflector, wherein all the inks form a single layer of ink on the media; and

after all the inks have been pre-cured, curing the single layer of ink with the illuminator that reflects radiation to the single layer of ink using a

cure reflector, wherein the radiation reflected by the cure reflector is more intense than the radiation reflected by the pre-cure reflector.

19. A method as defined in claim 18, further comprising printing each ink on the media.

20. A method as defined in claim 18, wherein pre-curing the wet ink that has been printed on the media further comprises pre-curing each ink immediately after each ink is placed on the media.

21. In a system using a substance that are cured using electromagnetic radiation, an illuminator for curing the substance, the illuminator comprising:

an electromagnetic radiation source located in a housing, wherein the electromagnetic radiation source generates the electromagnetic radiation used to cure the substance; and

reflector means for pre-curing a portion of the substance and for curing the portion of the substance that has already been pre-cured.

22. An illuminator as defined in claim 21, wherein the reflector means further comprises:

pre-curing means for directing the electromagnetic radiation to a portion of the substance to pre-cure the portion of the substance; and

curing means for directing the electromagnetic radiation to the portion of the substance to fully cures the portion of the substance after the portion of the substance has been pre-cured.

23. An illuminator as defined in claim 21, wherein the reflector means further comprises:

a pre-cure reflector positioned within the housing, the position of the pre-cure reflector within the housing being configured to direct radiation from the radiation source to the at least one ink to change a viscosity of the at least one ink without fully curing the at least one ink; and

a cure reflector mounted within the housing, the mounting of the cure reflector within the housing being configured to direct radiation from the radiation source to the at least one ink to fully cure the at least one ink.

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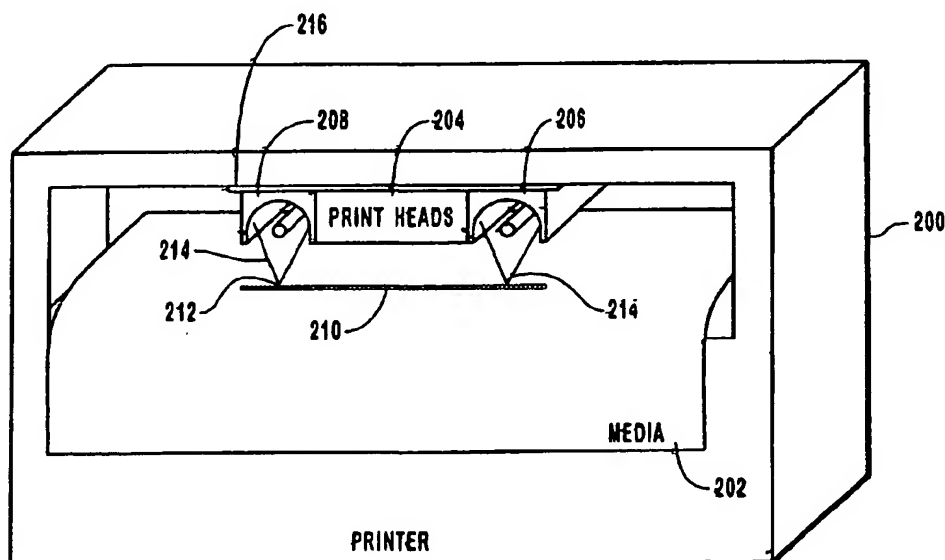
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(54) Title: **SYSTEMS AND METHODS FOR CURING A FLUID**



(57) Abstract: Systems and methods for curing inks with radiation. An apparatus includes a housing (216) that includes a pair of reflectors (206, 208) and/or two separate lamps of different power that direct ultraviolet radiation (214) onto inks (210) being cured. The pre-cure reflector (208) only reflects a portion of the radiation (214) such that inks (210) are not fully cured. The pre-cure reflector (208) causes the inks (210) to change or thicken slightly such that they do not move the media (202) or merge with other inks (210) while still retaining a liquid or wet nature. All colors of ink (210) can then be placed in a single layer before the cure reflector (206) fully cures the UV inks (210) by reflecting sufficient UV radiation (214) onto the single layer of UV ink (210).

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B. FIELDS SEARCHED

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U.S. : 347/102, 156; 399/320,336

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	US 6,145,979 A (CAIGER et al) 14 November 2000 (14.11.2000), column 2, lines 36-46.	1-23
A, P	US 6,454,405 B1 (STOWE) 24 September 2002 (24.09.2002), column 2, lines 4-51.	1-23
A	US 6,457,823 B1 (CLEARY et al) 01 October 2002 (01.10.2002), column 4, lines 4-32.	1-23

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
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